Speech Sounds, The Speech Circuit, and Embodied Meaning-Making Activity: An Ecosocial Perspective

If seeing or hearing involved extricating oneself from the impression in order to lay siege to it in thought, ceasing, that is, to be in order to know, then it would be ridiculous to say that I see with my eyes or hear with my ears, for my eyes and ears are themselves entities in the world and as such are quite incapable of maintaining on the hither side of it that area of subjectivity from which it is seen or heard. Even by making them instruments of my perception I cannot ensure that my eyes and ears retain any cognitive power, for the notion of perception is ambiguous: they are instruments of bodily excitation only, and not of perception.
M. Merleau-Ponty, Phenomenology of Perception, 1992 [1962], p. 212.

Phonic Substance, Phonological Form, and Levels of Relations in the Speech Circuit

Saussure begins his analysis of the speech circuit by postulating three fundamental levels of relationships (CLG: 28), as follows:

The point of departure of the circuit is of one [of the persons speaking], for example A, where facts of consciousness, which we shall call concepts, are associated with representations of linguistic signs or acoustic images which serve as their expression. Let us suppose that a given concept triggers a corresponding acoustic image in the brain: this is an entirely psychic phenomenon, followed in its turn by a physiological process: the brain

transmits to the organs of phonation an impulse which is correlative to the image; then sound waves are propagated from A's mouth to B's ear: a purely physical process. Next, the circuit continues in B in the reverse order: from the ear to the brain, physiological transmission of the acoustic image, in the brain, psychic association of this image with the corresponding concept. (CLG: 28)

*(1) a **psychic** act of association of "facts of consciousness" [faits de conscience], or concepts, and acoustic images in the individual's brain in virtue of the individual's being connected to a higher-order system of langue which is also somehow codified in the individual's brain as neural activity. Saussure suggests that consciousness, in its higher forms, is social- semiological in character and that the psychic nature of the linguistic concepts in consciousness means that these may be intentionally directed so as to enable the speaking subject to orient to semiotically salient phenomena in the world whenever the speech circuit is activated;*

*(2) a **physiological** act of brain-mouth and/or ear-brain transmission of nerve impulses which "codify" both the information stored in the brain as neural activity and the stimulus information which the organism picks up from its external environment by means of its perceptual systems;*

*(3) a **physical** act of the propagation of sound waves through the air from the mouth of the speaker to the ear of the hearer.*

The "faculty of association and co-ordination" (CLG: 29) whereby a concept is associated with an acoustic image in the individual's brain is not, however, a conscious act of will. Saussure de-locates this process of association from individual consciousness per se and re-locates it in the

language system [la langue], which is a social, rather than an individual, fact. “It is this faculty”, Saussure remarks, ” which plays the greatest role in the organization of langue as system” (CLG: 29). Thus, the individual’s brain is the physical repository of social-semiological meanings and values in the form of neural activity. A number of consequences follow from Saussure’s privileging of the language system. First, the study of the individual language user is circumscribed by social facts. Secondly, society is de-centred from the individual. Thirdly, the association of concept and acoustic image is **psychic** rather than psychological or physical. Whereas the latter pertain to the individual per se, the domain of the psychic in Saussure’s concept refers to the fact that the intentionally directed signifying acts which occur in the process of associating concept and acoustic image are always mediated by the social-semiological system of langue. On the other hand, the physical and physiological dimensions of speaking belong to the individual, hence non-social-semiological, domain of “execution”, over which the individual is “always master” (CLG: 13). The association of concept and acoustic image, on the other hand, is not an act of the individual’s conscious will per se. Rather, such acts depend on and are mediated by a higher-order system of langue. Langue may be seen as analogous to Peirce’s notion of thirdness, viz. a system of interpretance which allows sign-making activity to take place between individuals.

The speech circuit — le circuit de la parole — refers, by definition, to the instance perspective of language–in-use. It is the site of the re-production of the sign on the basis of the work — both individual and social — that is performed by the individual participants in the circuit. There is no authentic sign-essence at the same time that there is no thought which is present to the speaker’s consciousness at the time of speaking and which the sign merely re-presents.

The speech circuit both provides the general conceptual framework within which Saussure's phonological theory is best understood and the basis for linking it to recent theoretical developments concerning the ecosocial basis of meaning-making. In the speech circuit, the primary unit of analysis is not the individual (speaker and hearer) who participates in the circuit, but the processes that link speaker and hearer in a circular chain of interdependencies. These include the processes whereby matter, energy, and information cross the boundary between the individual and his or her immediate environment in the speech circuit. In this lecture, I shall attempt to show how and why Saussure's theory of speech sounds as embodied meaning-making activity provides a means of interfacing the individual participants in the circuit with the more global meaning-making activity which they jointly enact.

The central problem in Saussure's theory of phonology is how to overcome the antinomy between phonic substance and phonological form (see Lectures 3 and 4). This attempt can only be properly understood in the context of Saussure's discussion of the speech circuit. Phonic substance is just such a boundary between individual and environment in the sense that it is the interface between the speaker's bodily processes of articulation and the speaker-hearer's psychic orientation to the circuit as a meaning-making agent. If, on the other side of the overall sign-relation, thought-substance is the interface between perceptual phenomena which the agent experiences in the world and the conceptual categories of the signified, then phonic substance may be seen as the interface between the subject's own bodily processes of articulation and the phonological categories of phonological form. Just as the signified reconstrues the phenomena of experience as conceptual categories which are internal to the signified, so does the signifier reconstrue the information which the bodily processes of articulation encode in the acoustic flux of speech sounds as phonological categories.

The notion of substance in Saussure's account should not be taken to refer to that which supports or sub-tends form, as in the traditional account. Both phonic substance and conceptual substance are semiotically construed and motivated. Phonic substance is not simply the physical support of the phoneme category — the phonological form — that the physical sound is an instantiation of. Rather, it is a relationship between the speaker-hearer and the physical sound that is mediated by the phonological values — the phonic terms — of the given language system. In this view, the notion of semiotically construed phonic substance implicates the speaker-hearer's psychic orientation to the sounds in the speech chain. The mediated nature of this orientation to the spoken chain is clearly spelt out in the following passage:

In the act of phonation that we are going to analyse, we shall only take into account differential elements [which are] salient for the ear and capable of serving to delimit acoustic units in the spoken chain. Only these acoustico-motor units must be considered; thus, the abduction of r which accompanies that of p is for us non-existent because it does not produce a perceptible sound, or at least it does not count in the phonemic chain. (CLG: 83)

The system of phonological values thus globally ramifies throughout the speaker-hearer's perception of sounds in the spoken chain (section 9). The acoustic units which are, in fact, delimited in the spoken chain constitute a Gestalten which also depends in part on some principle of inhibition or negation (Bateson 1987 [1951]: 174). That is, the perception of some stimulus energy by the ear is inhibited, as in the case of the abduction of r in Saussure's example, so that the speaker-hearer may selectively attend to those acoustico-motor units that are relevant to the perception of the phonemes in question. In this way, we see how the system of values

organizes and directs the perception of acoustico-motor units such that some stimuli are favoured while others are ignored.

Phonic substance embodies, then, the contradiction between the material-phenomenal processes of the body in articulation and the speaker-hearer's psychic orientation to the phenomena of experience. On the side of the physical-material, phonic substance is the interface whereby energy and information exchanges take place between individual and environment. On the side of the psychic, phonological form is the semiological value which these exchanges have in the speech practices of a given community.

The Five Levels of *Parole*

Saussure proposes five interrelated levels of analysis in order to describe the chain of interdependencies that link phonic substance to phonological form in the speech circuit. These five levels constitute one continuous circuit of relations which link the physical, the physiological, and the psychic. The five levels are as follows: (1) vocal tract activity or articulation; (2) physical sound waves propagated from speaker to hearer; (3) the acoustic impressions received by the ear of the hearer; (4) the acoustic image; and (5) the phonological system of the language.

These five levels will now be discussed.

Vocal Tract Activity or Articulation

The vocal apparatus, in Saussure's description, is an articulatory space which controls the processes of articulation. The processes of articulation are "motivated phenomena" in the sense expressed by Merleau-Ponty (1992: 50). That is, there is an internal relation between the motivated phenomenon of articulation and the motivating phenomenon of auditory

perception. Saussure points out that it is impossible to motivate articulation on the basis of the "articulatory movements" alone. Instead, articulation is motivated on the basis of what the ear perceives in the spoken chain. "It is, Saussure points out, "in the chain of heard speech that one can hear whether a sound remains the same or not" (CLG: 64). That is, articulation is oriented to, or motivated by, the hearer's perception of it as phonologically salient units in the speech chain (see also Petitot-Cocorda 1985: 49). The vocal apparatus is an articulatory space which constrains and controls the production of speech sounds to this end.

Saussure makes a distinction between "the impression produced on the ear" and the "muscular image of phonation" (CLG: 28) or the "motor image of the organs [of speech]" (CLG: 63). He does not refer to the purely physical stimuli which the receptor cells (the cochlea) in the ear are stimulated by, or to the physical movements of the speech organs in articulation. In both cases, Saussure avoids such a physical reductionism. The distinction Saussure makes between the "acoustic impression" and the "motor image of the organs" serves to show that both the act of hearing (audition) and articulation (phonation) are phonologically motivated. The acoustic impressions which the ear perceives represent categorizing judgements about the sounds which are heard on the basis of the phonological categories which belong to the language system. The acoustic impressions are not reducible to physical criteria per se. Likewise, the "motor image" represents a categorizing judgement about the articulatory processes that are used to produce a particular speech sound. Saussure's terms show the dually categorial nature of speech sounds. Whereas the "acoustic impression" entails a categorizing judgement about a given sound from the point of view of audition, the "motor image" similarly involves such a judgement from the point of view of phonation, or articulation.

The phoneme is established on the basis of the following information which is encoded in the acoustic signal:

But in order to enumerate these factors of sound production, it is not enough to determine the differential elements of phonemes. In order to classify the latter, it is much less important to know in what they consist than in what distinguishes the one from the other. Thus, a negative factor may be more important for the purposes of classification than a positive one. For example, expiration, a positive element, which occurs in all acts of phonation, has no differentiating value, whereas the absence of nasal resonance, a negative factor, will serve, rather more than its presence, to characterize phonemes. The essential point then is that the two factors enumerated above are constant, necessary and sufficient for the production of the sound:

a) expiration,

b) oral articulation,

whereas the other two may be lacking or be subsumed to the first:

c) laryngeal vibration,

d) nasal resonance.

(CLG: 68-9)

Thus, Saussure's starting point is the description of the differentiating values – the phonic terms – which are encoded by the act of articulation in the acoustic flux.

The Acoustic Flux

Articulation encodes acoustic information in the acoustic flux. Articulatory information is not, however, encoded in a straightforward way in the acoustic flux.

Besides the phonology of types, there is, then, a place for a science which takes as its point of departure binary groups and sequences of phonemes, which is a completely different matter. In the study of isolated sounds, it is sufficient to observe the position of the organs; the acoustic quality of the phoneme is not at issue; it is fixed by the ear; as for articulation one is free to produce it as one pleases. But when it comes to pronouncing two sounds in combination, the matter is less simple; one is required to take account of the possible discordance between the effect sought and the effect produced. It is not always in our power to pronounce what we wanted. The freedom to connect phonological types is limited by the possibility of connecting articulatory movements. In order to take account of what happens in these groups, there remains to be established a phonology in which these would be considered like algebraic equations; a binary group implicates a certain number of mechanical and acoustic elements which condition each other reciprocally. When one varies, this variation has a necessary repercussion on all the others that can be calculated. (CLG: 78-9)

The fact that this information is extracted from the acoustic flux in the form of what Saussure calls "the acoustic impression" (CLG: 64) means that the encoding process is reversible. That is, the information encoded in the

acoustic flux in articulation is also decoded by the ear of the hearer as phonologically salient units in the speech chain.

The information encoded by articulation in the acoustic flux is phonologically relevant information. It is, as Saussure points out, dependent on the quality of the impression received by the ear. In other words, the ear responds to a structured array of phonologically salient information. The information encoded in the acoustic flux is comprised of variants and invariants which specify, in Gibson's (1986 [1979]: 51) sense, the articulatory parameters of their production. This information, as I showed above, does not reduce to the microscopic domain of the sound waves studied by acoustic physics. Instead, articulatory parameters such as [+ nasal resonance] or [- nasal resonance], and so on, refer to a macroscopic domain which is, as Petitot-Cocorda (1994: 23) argues, "morphological rather than physical in nature". This morphological level emerges from the microscopic physical processes which constitute its substrate. The macroscopic domain of these morphologies is both information bearing and phenomenal, rather than reductively physical-material, in character. The information in this domain is constituted by continuous sound spectra which are produced by the deformation of the vocal cavity in the process of articulation.

Audition

In Saussure's account, the ear as such is not stimulated by physical sound waves per se. Sound waves in the strict physiological definition are stimulus energy. They correspond to what Saussure calls the "raw acoustic sensation" [la sensation acoustique pure] (CLG: 28). It is this which excites or triggers a response in the receptors. The "raw acoustic sensation" is not perceived by the ear, which is a perceptual organ. The receptor organs (the cochlea, etc.) are stimulated by sound waves in the sense that the

receptors transduce acoustic energy into nerve impulses that are transmitted to the brain. However, this is not the same as the act of perception. Similarly, in the process of articulation, “the brain transmits to the organs of phonation an impulse which is correlative to the [acoustic] image” (CLG: 28). In neither case can the nerve impulse be said to correspond to the sound waves propagated in the air or to the acoustic image in the brain. In both cases, a process of systematic “translation” occurs whereby a given order of phenomena is “translated” into nerve impulses. That is why, for example, Saussure says that the nerve impulse is “correlative” to the acoustic image: there is a functional relationship of codification between the two orders of phenomena.

The ear, on the other hand, is activated by the acoustic information which it extracts from the acoustic flux of heard speech sounds. Saussure also refers to “the identification of this [acoustic] sensation with the latent acoustic image” (CLG: 28). This indicates that the acoustic image is not transmiited by the sound waves which constitute the “raw acoustic sensation” or, in modern terminology, the stimulus energy which trigggers a response in the receptors. The acoustic image is “latent” because it is stored in the brain of the speaker-hearer as a repository of phonological categories. Without such a repository of phonological categories, the speaker-hearer would have no means of “identifying” and, hence, of categorizing the information which is in the flux of acoustic energy as phonologically salient categories. We see here that Saussure equates the process of perception with what he calls the “identification” of the acoustic sensation with the acoustic image, rather than with the stimulus effect of the raw acoustic sensation on the receptors per se. This shows that he views perception as an active process of intervening in the acoustic flux and making relevant discriminations and judgements so as to extract the phonologically salient information. Perception, in Saussure’s account, is *active* rather than passive. In this, Saussure’s account is remarkably

consonant with James J. Gibson's ecological theory of perception. The distinction that I am drawing here between the stimulation of receptor cells (retina, cochlea, etc.) and the activation of the perceptual organs (eye, ear, skin, and so on) derives from Gibson (1986 [1979]: 53). In Gibson's theory, perception is an act of information pickup rather than a passive response to a stimulus (1986 [1979]: 56-7).

The ear does not perceive the microscopic physical reality of sound waves. This level of reality does not correspond to the ecosocial level which speakers and hearers inhabit. Instead, this is the domain described by the mathematical abstractions of physics. In Saussure's conception, the ear perceives the macroscopic phenomena corresponding to the informational variants and invariants in the acoustic flux. These are phenomenological, rather than physical, in character. They are phenomena of experience in the ecosocial reality of speaker and hearer. At no stage does Saussure claim that the ear perceives sound waves per se. Saussure uses the term "acoustic impression" (CLG: 64) to designate the qualitative and macroscopic character of the informational variants and invariants which the ear extracts from the acoustic flux: "the acoustic quality of the phoneme is not in question; it is fixed by the ear" (CLG: 78). The ear actively orients to and transforms the information in the acoustic flux into phonologically salient units:

It is in the chain of heard speech that it may be perceived immediately whether a sound remains identical to itself or not; as long as one has the impression of something homogeneous, the sound is unique. What is important is no longer its duration in crotchets or double crotchets (cf. fal and fal), but the quality of the impression. The acoustic chain is not divided into equal beats [temps égaux], but into homogeneous ones, characterized by the unity of the impression, and that is the natural point of departure for phonological study. (CLG: 64)

The “unity of the [acoustic] impression” is qualitative because it is based on the ear’s ability actively to reconstrue the chain of speech sounds as phonologically salient impressions. However, these impressions stand in no simple or direct relation with the phonological categories of the language system.

Auditory Perception: The Acoustic Image

The “unity of impression” designates equivalence classes of stimuli which the ear extracts from the speech chain. The problem is to explain how the “homogeneous” character of these stimuli is, in turn, perceived as a token of a particular phonological type. Saussure points out that this “unity of impression” is the “natural point of departure for phonological study” (CLG: 64). Let us now see why this so.

In his discussion of the speech circuit, Saussure expresses this problem in terms of the identification of the “pure acoustic sensation” with the “latent acoustic image” (CLG: 28). The acoustic image is “latent” for two reasons. First, it constitutes part of the psycho-perceptual processes which are internal to the individual and not therefore susceptible to direct observation. Secondly, the acoustic image is a global percept which mediates between the qualitative perception of “acoustic impressions” in the speech chain and their categorization as tokens of the phonological types (the phonemes) of a given language system. The acoustic image is the means whereby informational variants and invariants in the acoustic flux are construed as discrete units or catastrophic interfaces (Petitot-Cocorda 1985: 250) in the analog continuum of differences in the acoustic flux. As a global percept, the acoustic image constitutes a priori evidence for the speaker-hearer’s classification of the information which is encoded in articulation as corresponding to specific phonological values.

The acoustic image is a priori in the following sense: The qualitative basis of auditory perception means that the “unity” or the “homogeneity” of the acoustic impression remains stable in relation to the articulatory parameters which control it. The acoustic image controls the articulatory parameters (the specific configuration of phonic terms) which specify the domain of a given sound category. The qualitative nature of this perception means that a sudden change in one of these parameters will result in a qualitative change in the percept. That is, a sudden change of perceptual category will result.

A reconsideration of Saussure’s notion of the ‘acoustic image’ shows that Saussure had grasped the categorial basis of the perception of speech sounds. Saussure’s term ‘acoustic image’ has posed problems some for latter day commentators. For example, Roy Harris considers this notion to be “perhaps the most unhappy choice in the whole range of Saussurean terminology” and “more or less nonsense by present-day usage” (1983: xiv-xv; but see Langacker 1987: 78-9)

The ‘acoustic image’, it should be remembered, does not refer to the “purely physical process” (CLG: 28) whereby Saussure characterises the sound waves which are propagated from the speaker’s mouth to the hearer’s ear in the speech circuit. Saussure also points out that the acoustic image “is not the material sound, a purely physical thing, but the psychic imprint of this sound, the representation which gives us the evidence of our senses” (CLG: 98).

What, then, is the relationship between the physical-material substance of the sound waves and the listener’s “representation” of these to his or her senses? Saussure’s term ‘acoustic image’ is not the “unhappy” choice which Harris and, before him, Saussure’s editors took it to be (see footnote in Saussure). Saussure, in using this term showed that he understood the

fundamentally categorial nature of phonetic perception. The term ‘acoustic image’ is, then, anything but “unhappy”, or inappropriate. I shall now endeavour to demonstrate why this is so.

With this term, Saussure showed that the hearer ‘images’, or categorially construes, the physical-material reality of phonic substance. The phonology does not impose on sound — cf. Hjelmslev’s expression purport – a grid which is external to it. That is, it does not ‘cut up’ sound according to a pre-given schema. Instead, the categorial nature of the phonology means that the phonology itself has its own semantics. The function of this phonological ‘semantics’ is to construe and classify material-phenomenal sound events in the spoken chain as semiotically construed phonic substance in ways which have categorial significance in a given language system. Saussure’s ‘acoustic image’ is, then, an interface between the potential for physical-material sound events to have meaning, or significance, and the possibilities which these same sound events have to be categorially construed and symbolically organized as phonologically distinctive, or salient, patterns of differences within linguistic form. From this point of view, the phonology is, by analogy, the ‘grammar’ of the spoken signifier. Just like the grammar which organizes and symbolically construes ‘concepts’, this ‘grammar’ of the phonology has its own intrinsic categorial basis.

The Phonological System

Speaker and hearer are not simply connected to each other on the basis of the matter, energy and information exchanges which link them in the speech circuit. The flows of matter, energy and information which cross-couple speaker and hearer to each other also have phonological values. The categorization of phonological categories depends on semiological criteria of cultural salience. Whereas the basic parameters of phonetic

perception and categorization appear to be innate and universal, the perception of phonological categories, and, hence, the recognition of phonologically salient patterns in the speech chain, depends on the system of phonological values in the language of some community. Saussure has this to say about the role of the language system [langue] in the functioning of the speech circuit:

It may be localized in that particular part of the [speech] circuit where an auditory image is associated with a concept. It is the social part of language, exterior to the individual, and which he alone can neither create nor modify. It only exists in virtue of a sort of contract between the members of the community. (CLG: 31)

In the speech circuit, the language system is a psychic reality for speaker and hearer. Saussure's theory of phonology, or phonological form, replaces the substance-based criteria whereby the identity of phonological units was established on the basis of the "point of articulation" which subtends it with relational criteria. These relational criteria are purely positional and negatively defined. That is, the phonic terms in a given system of relations are not defined by positive and substantive criteria of identity. Phonic terms have no autonomous existence. Instead, the values of the terms in a given system of relations are defined by their reciprocal determinations in a system of phonic differences.

It is a fundamental postulate of Saussurean structuralism that the systemic organization of langue is purely relational and determined by abstract phonic and conceptual terms which have no positive identity of their own. The terms have no individual identity as such. Rather, they emerge as discrete categories from the analog continua of sound and thought, respectively. It is for this reason that Petitot-Cocorda (1985: 75; 1990

[1985]: 19) argues that Saussure's phonology is based on topological, rather than logico-combinatorial, criteria:

… the category of identity of position is an authentic category (a concept of pure understanding to repeat the Kantian terminology) which is the key to an objectivity which is symbolic in nature (structural objectivity), that is, to a regional ontology of a new eidetic type (not physical) and that makes obligatory a constituent moment in which this category is schematized. (Petitot-Cocorda 1985: 75; my translation; emphasis in original)

Structures are not based on logical principles of combination; nor are they based on typological ones. The central organizing concept, as Petitot-Cocorda observes, is that of a topological region.

What is a topology? Why is a topological perspective so important to Saussure's dynamic structuralism? A topology is a mathematical concept. In structuralist terms, it is a set of criteria for establishing degrees of closeness among the terms whose relationships constitute the structure. Thus, a structure is a region defined by the relationships among these terms. The recognition of a given structure means that the relationships which constitute it are seen as being in greater or lesser proximity to the criteria whereby the structure is defined. The terms which enter into some patterned relationship are defined as being closer to or further from these criteria. There may be more than one criterion. Criteria are defined by relations of similarity and difference along some dimension. A given instance of some phenomenon can be represented as being more or less alike with respect to these abstract criteria. Phonemes are represented by the clustering of points in an (abstract) topological space. Such 'clusters' are necessarily defined by distributional principles.

From Microscopic Complexity to Macroscopic Simplicity: The Dynamics of Articulation

Saussure's phonological theory begins with the problem of how complex patterns of muscular movements at the microscopic level of articulation produce patterned regularities in speech sounds. Saussure calls into question the traditional approach of phonologists. In the traditional approach, the focus is on the "act of phonation, that is the production of sounds by the organs (larynx, mouth, etc.) (CLG: 63). Saussure, in arguing against this approach, shifts the focus from the act of phonation to what he initially refers to as the "impression produced on the ear":

… not only are the impressions produced on the ear given to us as directly as is the motor image of the organs, but it is also here the natural basis of the entire theory. (CLG: 63)

This shift in focus raises the question as to how regular and persistent patterns – auditory impressions – arise from the microscopic complexity of the muscular movements involved in the act of phonation. How is it that such microscopic complexity gives rise to such ordered, macroscopic simplicity? Saussure does not assume that the act of phonation is a mere aggregration of simple, elemental muscular movements which form something more complex. He does not assume, in other words, that something complex and detailed arises out of some prior simplicity. Indeed, he assumes the opposite point of view. That is, macroscopic simplicity arises from microscopic complexity. The following passage makes this clear:

Many phonologists set store almost exclusively by the act of phonation, that is to say, to the production of sounds by the organs larynx, mouth, etc.), and neglect the acoustic side. This method is not correct: not only is the impression produced on the ear given to us as directly as is the motor image of the organs, but it is also the natural basis of the whole theory.

The acoustic given already exists unconsciously when one approaches phonological units; it is by the ear that we know what a b, a t, etc. is. If one could reproduce by cinematographic means all the movements of the mouth and the larynx while executing a chain of sounds, it would be impossible to discover the subdivisions in this sequence of articulatory movements; one would not know where one sound begins and where the other ends. How can one affirm, without the acoustic impression, that in fal, for example, there are three units, and not two or four? It is in the chain of heard speech that one can immediately perceive whether a sound remains the same or not; as long as one has the impression of something homogeneous, this sound is the same. (CLG: 63-4)

This passage reveals the practical impossibility of analysing the sheer complexity and microscopic detail of the muscular movements involved in phonation. But that is not all. Saussure's point goes well beyond the practical difficulties of such an enterprise. It is the ear, he argues, that makes relevant distinctions. In other words, he argues that a different level of description is required. This new level of description is distinct from the language used to describe the neuromuscular processes which constitute the dynamics of phonation. Saussure does not say, however, that the ear perceives sensations of sounds as stimuli to neural activity. The ear has quite a different function in Saussure's conception. The neuromuscular processes involved in phonation belong to the domain of the physical and the physiological, as Saussure points out in his discussion of the speech circuit. The ear, on the other hand, belongs to the domain Saussure calls

the psychic. Physical and physiological phenomena do not have intentional content. The term “psychic”, in contrast, implies an activity that is intentionally directed. This entails criteria of agency and meaning. It requires a level of description which is distinct from, though related to, the physical and physiological processes that constitute its neuroanatomical substrate. Saussure proposes the notion of acoustic impression in precisely this sense. The ear contextualizes sounds in the speech chain as corresponding to this or that acoustic impression. In making this distinction between the lower level, non-intentional physical and physiological processes and the higher level intentional or psychic processes, Saussure raises the question as to how it is that intentionally directed and meaningful acts emerge from and constrain the regularities of non-intentional physical processes. The ear, in Saussure’s account, does not simply and passively receive raw physical sensations as inputs. Instead, it functionally constrains in significant ways the regularities of the speech chain. As we saw in Section 2, it is the “quality of impression” (CLG: 64) which matters is the quality of the auditory impression rather than the purely quantitative level of description that characterizes the lower level neuromuscular processes of phonation. ‘Qualitative’ refers to the acoustic impressions as intentionally directed states that emerge from and constrain the lower levels.

The two levels of description are not commensurate. Nor is the one reducible to the other. That is why Saussure argues for two distinct levels of description – the one quantitative and the other qualitative. His point is that the physical and the physiological structures and processes that support a meaningful act are not to be confused with the act itself.

The mouth, the larynx, and the other organs of speech have the ontological status of things. The mouth is not an act of parole. The mouth, larynx, and so on, and the co-ordinated relations between them in the act of speaking constitute the anatomical support of the act of speaking. They are the

material cause of the act of speaking. But speaking is not reducible to the anatomical level. Speaking is an intentional act of an agent who is endowed with agentive capacities and dispositions such as “will” and “intelligence” (CLG: 30). The act of speaking entails the release of these capacities and intentions in relation to some purpose or intention of the speaker. Speaking is a psychic act. This means that it is functionally organized and directed by the relations it enters into. Relations have a fundamentally different ontological status from things. The neuroanatomical processes involved in phonation realize the qualitatively different act of speaking. The act of speaking, rather than being reducible to the lower level descriptive language of its neuroanatomical substrate, is described with reference to the functional, or psychic, relations it enters into in the speech circuit. This explains Saussure’s insistence on the qualitative nature of the acoustic impression. The acoustic impression specifies speech sounds with reference to the function they perform in the speech chain, rather than to the neuroanatomical processes that produce. The act of parole is, then, a psychic act that is both ‘executed’ and ‘received’ as such in the speech circuit. Acts of parole are necessarily defined with reference to the other in the circuit. They have no status outside the speech circuit.

The intentional character of acts of parole has, then, qualitative (functional) relations and properties that are not reducible to the quantitative level of the neuroanatomical processes that produce them. This intentional character emerges from the lower level physical processes in the sense that these constitute the physical-material (anatomical) resources that are potentially configured in the act of speaking. At the same time, the intentional character of the act of parole constrains the lower level physical processes. That is, it specifies how these are to be deployed so as to achieve specific intentional effects in the act of parole.

The situation described in the previous paragraph is the exact reverse of the classical Newtonian model of causality. In the Newtonian model, mechanical forces operate on physical entities according to universal and lawlike regularities. In the situation described by Saussure, on the other hand, it is the intentional character of the act of parole which constrains the lower level neuroanatomical processes. At the same time, the act of parole is not entirely independent of these. In other words, the semiological values which the ear confers on particular distinctions in the speech chain imply contextualizing constraints by means of which the bodily, and in particular the articulatory, resources of the individual are deployed and directed to enact particular semiological functions in the speech circuit. These semiological values arise from the higher-order social-semiological system of langue. In hitting upon this insight, Saussure anticipates some of the most recent developments in physical biology concerning the function of non-holonomic versus holonomic constraints in living systems.

Holonomic constraints refer to the microscopic world of mechanical causality described by Newtonian physics. At this level, physical processes occur according to lawlike regularities. The microscopic domain of holonomic constraints uses the language of motion and forces causally acting upon particles from the outside. Non-holonomic constraints, by contrast, refer to the macroscopic domain of intention and meaning. This level is neither reducible to nor explainable in terms of the lower level language of motion and forces.

Saussure (CLG: 64) recognizes the difficulty in describing the microscopic detail of the mechanical (holonomic) level of the articulatory movements. The “acoustic impression” is a macroscopic constraint of the non-holonomic sort. Acoustic impressions are not caused by the lower level physical and physiological processes. Instead, they emerge from these at the same time that they constrain and organize their further dynamics. Saussure

recognizes, in effect, the stratified nature of the relations between these two levels. This is clear in his definition of the phoneme: “the sum of acoustic impressions and of articulatory movements, of the unit which is heard and that which is spoken, the one conditioning the other: it is therefore a complex unit which has a foot in each chain” (CLG: 65).

In other words, the phoneme is described from the point of view of two distinct, though complementary, perspectives. The two levels designate two different scales – one quantitative and the other qualitative – of reality. In this way, Saussure proposes a theoretical strategy for overcoming the theoretical antinomy between phonic substance and phonological form. It is a theoretical strategy which endeavours to provide a unified account of the semiological relations which link these two levels.

Saussure’s Account of the Phoneme in the Spoken Chain and the Emergence of Global Order from Local Variability

Saussure’s definition of the phoneme is strikingly different from the central program conception of behaviour in modern cognitive science. In this respect, Saussure is much closer to recent biophysical theories of movement control (e.g. Kelso 198?). Researchers in this area of inquiry see order and regulation of movement as “an emergent property, as an a posteriori fact, dependent on the dynamical behaviour of the system” (Kelso 198?: 438). The recent developments in physical biology reported by Kelso suggest that the need for a central and a priori program which is “independent of and causally antecedent to systemic behaviour” is obviated (Kelso 198?: 438; emphasis in original).

The question is no longer one of which central program causes actual and observable behaviour. Rather, the question becomes one of how the various levels “relate to and influence each other” (Kelso 198?: 438). In my view, this is the problem Saussure attempts to tackle in his phonology. The five levels of description he proposes with respect to the phoneme are distinct, though interrelated, levels. It is the dynamical behaviour, rather than a posteriori (a priori ?) causes, which explains the emergence of phonological categories. The one influences the other.

This raises the question as to how intentional (psychic) behaviour can constrain and control the lower level physical and physiological processes. The first conceptual barrier to overcome in answering this question is the notion that this occurs in the same way that forces causally act upon moving particles in the mechanical language of the Newtonian paradigm.

The language of the central program which causally directs behaviour fails to offer a satisfactory explanation. Kelso expresses the problem as follows:

… the contents of the so-called program are discrete, timeless, and context-free; yet the characteristics of activity are continuous, dynamic, and context-sensitive. (Kelso 198?: 441)

Saussure recognises the same problem when he makes a distinction between the ‘concrete’ and the ‘abstract’ dimensions of analysis:

The elements that one first obtains by the analysis of the spoken chain are like the links of this chain, irreducible moments that cannot be considered outside of the time that they take up. Thus an ensemble such as ta will always be one moment then another moment, a fragment of a certain duration, then another fragment. On the other hand, the irreducible fragment t, taken on its own, can be considered in abstracto, outside time.

One can speak of t in general, as being of the type T (we shall designate types with capitals), of i as being of the type I, attributing no distinctive character to them, without being concerned with everything that depends on succession in time. (CLG: 65-6)

Saussure recognizes the temporal and contextual nature of the activity of producing and comprehending the speech chain. Saussure's conception of the speech circuit shows that there are no conceptual barriers that separate the psychic and the non-psychic (physical and physiological) components of the circuit. The two dimensions are not totally separate in the sense that the psychic is not the cause of the non-psychic. Rather, the two dimensions are linked in a continuous chain of interdependencies by virtue of the information which passes around the whole circuit. The problem of the conceptual barriers between the two domains can be solved. The starting point for solving this problem is to understand that Saussure does not have recourse to the language of causality in order to explain the relationship between the two domains. The psychic is not a central program which is either 'independent of' or 'causally antecedent to' the behaviour of the organs of speech in the act of phonation. That is, the psychic component is not a central program in the brain of the individual and which causally guides his or her behaviour.

The above passage shows Saussure's awareness of the importance of both the specifics of the specific spoken chain as it unfolds in time and the existence of general types occurring "outside of time". These general types are, then, removed or abstracted from the here-and-now of the "succession of time". They are global structures whose function it is to discriminate the detail of specific, moment-to-moment contexts. In the language of dynamic systems theory, the general types identified by Saussure are deep attractors that have emerged through many instances of perceiving and acting across many different specific contexts. This is the historical time-

scale whereby langue is built up in the individual's brain. As such, they embody a different time-scale from that which refers to the moment-to-moment succession in time of elements on some specific occasion (parole). The emergence of general types occurs over time on the basis of the continued interacting of heterogeneous system variables. The formation of these deep attractors is the result of the building up over time of trajectories of motor and perceptual activity. Importantly, the general types are not central plans or schemata which generate specific behaviour.

Now, modern cognitive science explains the local variability of human activity and behaviour in terms of underlying plans and structures which generate behaviour. In the process, followers of these approaches tend not to explain the detail of actually occurring behaviour. Saussure, by contrast, starts with the local detail of the succession in time of elements in the speech chain, that is, in parole. Further, he recognizes that there is global patterning and structure in these details. However, he does not try to explain this in terms of some kind of constant program or schemata which underlies the behaviour and which causes it. Instead, he realises that the "irreducible moment" and the "general type" are but two complementary perspectives on the same phenomenon. The contextual here-and-now of "succession in time" is the means whereby the global order — the general types — emerge. That is, the latter are the result of the system's accumulated history of speaking and listening on many other occasions prior to the specific occasion to hand. Secondly, the occurrence of one "fragment" influences or determines the next "fragment", and so on according to the particular "succession in time" of fragments. Thirdly, the local succession of elements in time adapts the past history of the system to the here-and-now activity. Thus, we see how the two temporal dimensions reciprocally implicate each other in any given act of speaking.

Saussure's discussion of the speech circuit shows that the behaviour of the participants in it is guided by the information which flows continuously in the circuit. This information belongs to the ecosocial, rather than the physical, level of reality. Regularity and control of articulatory movements is an emergent and distributional property which are information-guided. Saussure does not say that the acoustic image represents some sort of pre-existing plan which is 'stored' in the brain. Rather, the phonemes which are identified in the spoken chain are a posteriori facts of the emergent systemic properties of the lower level articulatory processes:

… it is necessary to remember that a phoneme is identified when one has determined the act of phonation, and that reciprocally one will have determined all the types of phonemes in identifying all the acts of phonation. (CLG: 69)

Instead of a priori or prescriptive programs Saussure emphasises the way in which regularities in articulation are dependent on the systematic relations among all the variables involved. Initially, Saussure establishes the following three differentiating criteria:

… what its oral articulation is, whether it comprises a laryngeal sound ( ) or not ([]), whether it involves nasal resonance (….) or not ([]). When one of these three elements is not determined, the identification of the sound is incomplete; but as long as all three are known, their different combinations determine all the essential types of acts of phonation. (CLG: 69)

In other words, some differentiating variables must remain constant if the structural integrity of a given act of phonation is to be preserved and if a given pattern of neuroanatomical movements is to be categorized as an instance of the same type of articulatory act.

Saussure's rejection of the 'place of articulation' as a basis for classifying speech sounds allows for the fact that variables in the articulatory process itself need not adversely affect the topological basis of phonological categories:

Generally sounds are classified according to their place of articulation. Our point of departure will be different. Whatever the place of articulation, it always displays a certain aperture, that is to say, a certain degree of openness between two extremes which are: complete closure and maximal openness. On this basis, and on going from minimal aperture to maximal aperture, the sounds will be classified into seven categories designated by the figures 0, 1, 2, 3, 4, 5, 6. It is only within each of these that we shall divide up the phonemes into diverse types according to their own place of articulation. (CLG: 70)

The flow of information in the speech circuit shows that criteria based on unilinear causal principles and/or isolated things or entities instead of systemic interrelationships are mistaken. It is the emergent systemic characteristics of the system as a whole, rather than isolated phenomena, that explain speech sounds. Saussure argues for a phonological science that takes account of the ways in which sounds combine and effect each other in the unfolding speech chain (see above). The 'freedom' to link speech sounds in the spoken chain is not defined by centrally determining causal principles. Instead, it is defined by the time-bound operating conditions of the articulatory organs themselves. That is, the two levels – the "mechanical" and the "acoustic", respectively, – interface with and regulate one another in a continuously cyclic process.

This may be fruitfully compared to Kelso's description of the processes of entrainment in the self-organizing co-ordinative structures that regulate rhythmic movement in biological organisms:

Self-organizing, autonomous systems become viable, it is thought, when many cyclical processes become entrained. The latter homeokinetic scheme denotes systemic behaviour as established by an ensemble of nonlinear oscillators that are entrained into a coherent harmonic configuration […] For homeokinetics, limit cycle entrainment ensures a solution to the degrees of freedom problem of movement control. (Kelso 198?: 450)

The processes of entrainment are an emergent property of many interacting nonlinear systems. Articulation is self-organizing on account of the way in which many different interacting systems are all oriented in a unitary way. That is why, in my view, Saussure argues for a phonological science that takes as its point of departure the complementarity, rather than the antinomy, of phonic substance and phonological form in the definition of the phoneme.

The Relevance of Gibson's Theory of Stimulus Information to Saussure's Account of the Ear

Saussure's ecosocial perspective is evident in the following discussion of what the ear perceives in the act of phonation:

In the act of phonation that we are going to analyse, we shall only take account of differential elements, salient to the ear and capable of being useful in the delimitation of acoustic units in the spoken chain. Only these acoustic-motor units must be considered; thus the articulation of the abduction of r which accompanies the abduction of p is non-existent for us, because it does not produce a perceptible sound, or at least, it does not matter in the phonemic chain. (CLG: 83)

For Saussure, the perception of speech sounds is based on the principle of differentiation. This distinguishes him from the theory of association developed by the British empiricists such as Locke, Hume, Berkeley, and James Mill. According to the empiricists, ideas are simply associated with sensations. The original associations are not modified by experience or by learning. Saussure's conception is much nearer that of the psychophysiology of William James (1890), who was an important critic of empiricist and sensation based theories of perception. At the same time, James was also an important precursor of the Gestalt movement in psychology which was subsequently developed by Koffka (1935) and Kohler (1929).

In Saussure's model, the ear does not perceive raw physical sensations which are then associated with ideas in the brain. Instead, the ear perceives "salient differences" which are "capable of serving for a delimitation of acoustic units in the spoken chain" (CLG: 83). The differences which the ear perceives are not, then, the sound waves which are propagated from the mouth of A to the ear of B in the speech circuit. Rather, the "salient differences" which the ear perceives specify, in Gibson's sense, the speaker's act of phonation to the hearer. These "salient differences" constitute environmentally relevant acoustic information about the speaker. However, information in this sense is not specific to the invariants – the salient differences – in the spoken chain per se.

The point is that this information specifies a particular type of relationship between the hearer's act of perceiving and the motor act of phonation (articulation) on the part of the speaker. The differences which the ear perceives are specific to an ecosocial event (Gibson 1986 [1979]: 226). Speaker and hearer are reciprocally oriented to each other. The speech circuit that links speaker and hearer does not imply an empty physical

space between speaker and hearer and through which sound waves are transmitted.

To be sure, sound waves are propagated from a mechanical event and in turn they may stimulate the receptor cells of the hearer. More important, however, is the medium that links speaker and hearer. The flow of acoustic information in the medium controls and orients the reciprocal relations between speaker and hearer in the circuit (Gibson 1986 [1979]: 225).

Control lies, then, in the perceptual-informational, rather than mechanical, cross-couplings between organism and environment. Information is not sent or conveyed from speaker to hearer as physical stimuli in the way the transmission model suggests. To be sure, stimulus energy in the form of sound waves is propagated from a source. But that is not the same as the acoustic information to which the ear responds. The latter is stimulus information in Gibson's sense. Sound waves, as acoustic energy, are necessary in order that the receptor cells (cochlea, etc.) are stimulated. But that is not the same as the structured array of acoustic information which the auditory system as a whole requires in order to respond to information about its environment. Stimulus energy (sound waves) is the matter-energy bearer of stimulus (acoustic) information. Stimulus energy has a purely physical status. It belongs to the microscopic domain described by Newtonian physics. Stimulus information, by contrast, has a phenomenological status. It belongs to the macroscopic domain of the morphological organization of the phenomenon of experience. In Gibson's ecological theory of perception, this is the domain which the sensory systems of the organism are cross-coupled with. This domain emerges from its lower level physical substrate, but is neither reducible to it nor is it caused by it.

The medium is not an abstract and empty physical space in the Newtonian sense. The medium is what allows a steady state of acoustic (or other) information to flow through the whole environment and in ways that contain information about that environment. There is, as Gibson (1986 [1979]: 226) points out, “an array at every point of observation and a changing array at every moving point of observation”. The “salient differences” that Saussure discusses are not physical stimuli which are transmitted from A to B. Rather, they are acoustic information about some environmentally significant event. A suitably positioned observer – mobile or stationary – is able to pick up and respond to this information from any given potential point of observation relative to the flow of acoustic information in the environment.

Information in this sense is an emergent property of the whole system of relations, as shown by the five levels which Saussure postulates in order to explain the dynamical and dialectical character of the relations between phonic substance and phonological form. A good illustration of this is Saussure’s discussion of syllabic boundaries and vocalic peaks:

If in a chain of sounds one passes from adduction to abduction (>I<), a particular effect is obtained which is the index of the syllabic boundary, for example in ik in particulièrement ('particularly'). The regular coincidence of a mechanical condition with a determinate acoustic effect assures the group adductive-abductive a distinctive place in the phonological order: its character persists no matter what [phonological] types it is comprised of; it constitutes a genus containing as many species as there are possible combinations. (CLG: 86-7)

It is the “regular coincidence of a mechanical condition with a determined acoustic effect, or the systematic relations among many such variables,

that assures the regularity of the phonological group “adduction – abduction”.

Saussure’s point is that there is no fixed or determinate and a priori relationship between the muscular movements involved in articulation and the production of particular acts of phonation. An act of phonation is a co-ordinated use of the articulatory resources in a particular context (Kelso 198?: 445). In the above passage, Saussure draws attention to the way in which a particular invariance – the syllable boundary – is maintained by a co-ordinated configuration of “mechanical [articulatory, PJT] conditions” in a given phonological context. It is the change from “adduction” to “abduction” that indexes the syllable boundary.

The Intentional Modulation of Physiological Necessity

Saussure’s point is that this variable must remain stable if the particular phonological act which is indexed is to be recognised even when other variables may change. In keeping with some of the most recent developments in the biophysics of human movement and its control, Saussure does not propose an a priori and prescriptive motor program. What interests Saussure are the invariant properties of the act of phonation in the space-time of the unfolding act itself. A few pages further on, Saussure makes the following comments on this question:

… in the analysis of the syllable, as it appears in the [spoken] chain, we have obtained the irreducible unit, the opening sound and the closing sound, then in combining these units, we have arrived at a definition of the limits of the syllable and the vocalic peak. We now know in which physiological conditions these acoustic effects must be produced. The

theories criticised above follow the inverse order; one takes isolated phonological types, and from these sounds one presumes to deduce the limit of the syllable and the position of the sonant. But given any series of phonemes, one way of articulating them may be more natural, easier than another; but the possibility of choosing [la faculté de choisir] between opening and closing articulations remains to a large extent, and it is on this choice, not directly on the phonological types, that syllabification depends. (CLG: 89)

It is the "possibility of choosing", which is an intentional act or a constraint of the non-holonomic sort, which controls and directs this process. However, this is not externally imposed, but arises from within the overall system of relations involved. Saussure shows here that a modality of 'choice', rather than what is 'natural' per se, intentionally directs the process of syllabic formation. In other words, the psychic emerges from the co-ordination and entraining of the lower level physical and physiological processes. The level of natural necessity does not causally predetermine the structure of the act of phonation. Instead, higher order non-holonomic constraints of 'will' and 'intention' can modulate co-ordinated acts of phonation. Speaking of what he calls "broken adductive chains" and "broken abductive chains" (CLG: 89-90), Saussure concludes:

In all cases of this genus, will and intention may, in intervening, allay suspicion and to some extent shift physiological necessity; it is often difficult to say exactly which part belongs to each of the two orders of factors. (CLG: 90)

Saussure recognizes that the hearer's perception of the act of phonation is not entirely based on 'objective' or 'natural' criteria at the level of physiological necessity. However, the difficulty in distinguishing the two orders of factors suggests that "will" and "intention" are not properties which

exist on an entirely separate level of relations. Saussure points to the way in which these properties are, in fact, potentially immanent in the lower level of physiological necessity. Hence, the individuating and teleological modalities of “will” and “intention” emerge from logically prior physiological necessities. The more specific properties of the former are logically dependent on and embedded in a still more general system of necessities. The physiological necessities that Saussure refers to are material processes; on the other hand, “will” and “intention” bring us to the question of meaning. Saussure draws attention to the ways in which meaning categories affect embodied material processes and actively shape them. The mediation of material processes by meaning amplifies and extends the effects of matter itself beyond its immediate spatial and temporal scale. The material is connected to larger-scale cultural and semiotic processes that have a history in a human cultural system (Hjelmslev 1954: 178-9; section 9).

The difficulty Saussure that acknowledges in the above quotation in distinguishing the two orders of factors shows his awareness of the way in which social-semiological and embodied material processes and relations on very different scales intersect without any clear means of saying where one level begins and the other ends. Thus, the intentional or willed modulation of vocal tract activity in the act of speaking shows how higher scalar social-semiological “factors” such as, for example, social or class habitus (class and social accents, for instance) are directly embodied and implicated in lower scalar physiological processes. In this way, an entire generation’s or social class’s way of speaking is embodied in the here-and-now act of speaking by the individual.

The perception of the speaker’s articulatory act is also intentionally or psychically directed. This means that the hearer’s perception is also based on cultural expectations as to the meaning and value of the given

phenomenon. Saussure illustrates this aspect of perception in connection with the duration of implosion and explosion:

The real reason is that abduction [l'explosion] and adduction [l'implosion] are essentially different in relation to duration. The first is always so rapid that it remains an irrational quantity for the ear; it is for this reason too that it never gives a vocalic impression. Only adduction can be appreciated; hence the feeling [le sentiment] that one remains for a longer period on the vowel from which it begins. (CLG: 90-1)

Only adduction can be "appreciated", as Saussure remarks, on account of the cultural expectations which shape our perception of the acoustic information which is made available to the ear. The ear imposes intentionally directed expectations and evaluations ('appreciations') on the acoustic information to which it responds. In so doing, it gives shape to the perception we have of qualitative differences in the speech chain. That is what 'salient' means – differences that make a difference in some social-semiological system of meanings and values.

On the other hand, abduction is said to be an "irrational quantity" for the ear because it does not make a phonologically salient difference. For this reason, it is not construable as a globally homogeneous acoustic impression. The "feeling" [le sentiment] that this is of longer duration acquires qualitative significance in the relevant phonological context. Saussure's point is that "only the adduction can be appreciated" in this sense. This is so because the perception of the relevant (salient) difference does not depend on physical or quantitative criteria per se. Rather, it depends on intentionally directed or psychic criteria as to the significance which a given phonic difference has in the overall context of the speech chain.

The Encoding and Decoding Perspectives On the Articulation and Construal of Speech Sounds

On the basis of this two-way relationship, it is possible to specify a number of different perspectives, depending on the point of view which is adopted. It is possible to look at this relationship from either the point of view of the acoustic impression (decoding) or that of the oral articulation (encoding). It is important to keep in mind that these two terms are not simply equated with each other in the coding relationship. Instead, the relationship is one of symbolic construal or realisation. This means that the two terms are on two different levels of symbolic abstraction in the sense that one is the realisation of the other. This relationship refers to the fact that the two terms are on different strata in the one overall system, a fact which Saussure recognised in his discussion of the way in which a more concrete acoustic image signifies a more abstract concept in the sign (CLG: 98). In the analysis which follows, I am claiming that the stratum of the signifier — the spoken chain — may itself be internally stratified into the two levels of symbolic abstraction that Saussure designates as the acoustic impression and oral articulation, respectively. I shall adapt Halliday's metagrammatical terminology in his discussion of relational identifying clauses in order to represent this semiotic relationship between more concrete and more abstract levels of symbolic construal with the terms Token (T) and Value (V), respectively (Halliday 1994: 124-8; see also Davidse 1992). Thus, a more concrete Token signifies, realises, or symbolically construes a more abstract Value. This yields the following eight possible construal relationship, as set out below:

The eight possible construals of the semiological relationship between acoustic impression and oral articulation constitute a refinement of the distinction which Gibson and other psychologists have made between proprioception and exteroception. I have already proposed that Saussure's stratal conception of the sign represents an alternative to psychophysical dualism (section 9). Gibson (1986 [1979]: 116) argues that the information to specify the self, including the embodied nature of participants, "accompanies" the information to specify the ecosocial environment. The two perspectives are complementary aspects of a single overall phenomenon. Proprioception designates information about the self; exteroception information about the environment. Both of these poles of awareness entail potential points of observation relative to either self or environment. Proprioception means that when an organism occupies a given point of observation two kinds of information about the observer become available. The first is information which is available to others. For example, information about the speaker which is made available to the hearer. The second is information about the speaker which is available only to the speaker. For example, when the speaker hears him- or herself speak. The two perspectives are discussed in the next section.

Proprioception and Exteroception in Relation to the Performance and Construal of Speech Sounds

The eight different construal relationships summarised above provide a means of showing more systematically some of the possibilities which the two poles of attention – proprioception and exteroception – make available to speakers and hearers. Saussure provides us with the following clues as to the principles involved in his discussion of the linguistic sign:

The psychic character of our acoustic images appears very clearly when we observe our own language [langage]. Without moving the lips, we can speak to ourselves or recite to ourselves a piece of verse. It is because the words of the language system [la langue] are for us acoustic images that it is necessary to avoid speaking of the "phonemes" of which they are composed. This term, which implicates an ideal of vocal activity, can only be appropriate for the spoken word, for the realization of the interior image in discourse. In speaking of the sounds [sons] and the syllables of a word, this misunderstanding is avoided, as long as one remembers that it is a question of the acoustic image. (CLG: 98)

In the context of the overall discussion of the sign-relation, Saussure, in this paragraph, draws attention to the psychic character of the acoustic image. He points out that the acoustic image provides us with information about our own bodies in relation to the "phonemes" of the language. The acoustic image is not a physical sound which is 'executed' or heard, but a schematic category of sound.

Langacker (1987: 78-9) provides some further useful observations on this issue. Indeed, Langacker's arguments are strikingly Saussurean. After explaining that speech sounds are categorial – Langacker's term is 'conceptual' — without necessarily having any overt physical manifestation, Langacker notes that the linguistic coding of sound categories, while associated with their phonetic status as audible sounds, does not preclude a range of possibilities whereby we mentally "hear", as Langacker (1987: 78) puts it, a vocal sequence when no physical sounds are actually uttered. As Saussure had already pointed out, Langacker argues along similar lines that sound categories derive in the first instance from auditory impressions, and "only indirectly from the sound waves that give rise to these impressions" (1987: 78). Langacker has this to say about the complementarity of acoustic impression and oral articulation:

Even the articulatory facets of speech sounds are properly regarded as conceptual, in the broad sense in which I understand this term. Consider the segment [i]. From the conceptual standpoint, speakers can deal with this sound in either of two ways: they can actually hear the sound as a stimulus-driven perceptual event, or they can simply imagine hearing it, i.e. they can activate an auditory image of it (as in silent verbal thought). Moreover, the auditory image is plausibly taken as primary, in the sense that it is used to categorize acoustic input as an instance of this particular sound. Exactly analogous observations can be made about the articulatory representation of [i]. A speaker can actually implement the articulatory routine and produce the sound, or he can simply imagine implementing it, i.e. he can mentally run through the motor routine without this mental activity being translated into muscular gestures. Once again the cognitive representation is primary, in the sense that it directs the motor sequence but can also occur autonomously. (Langacker 1987: 78-9)

Langacker provides some useful refinements of Saussure's position. However, the main problem in his position, along with that of Gibson and, indeed, Saussure, is that they all operate the dichotomy of 'public' and 'private', along with the related dichotomy of 'language' and 'thought'. The earlier passage from Saussure draws attention to the ways in which 'talking to ourselves' and 'silent reading' are, in actual fact, inner specializations of the same social-semiological resources which we use in outwardly observable forms of speech. The fact that both the acoustic impression and the oral articulation need not be physically actualised as vocalisations in outwardly observable speech, but may be actualised in an 'inner' realm, shows that there is continuity across the boundary which separates the individual biological organism from the ecosocial environment. This continuity suggests that the dichotomies of 'public' and 'private' and 'outer' and 'inner' are, in actual fact, specific appropriations and specialised deployments of the same social-semiological resource systems (Lecture 7).

From the perspective of the acoustic image, these various specializations entail differential cross-couplings of the acoustic image with different manifestations of phonic substance. This means that there are different strategies for construing the relationship between the analog continuum of expression-purport and the acoustic impression or the oral articulation. The two main strategies are those of ‘encoding’ and ‘decoding’, referred to above. Each of these further entails either an actual or a virtual relationship to Saussure’s amorphous “sound” (cf. Hjelmslev’s expression-purport). In each cases, “actual” means that muscular activity is deployed to produce physical sound events that may be heard by others; “virtual”, on the other hand, means that no such muscular activity occurs. The two perspectives of, respectively, ‘decoding’ and ‘encoding’ are compared in Figure 1:

Figure 1. Decoding and Encoding perspectives on Speech Sounds in Speech Circuit

Overall, there are eight possible mappings of phonological form onto phonic substance. These are set out below.

I. Acoustic Impression (Decoding):

1. the hearer actually hears the speaker;

2. the speaker actually hears him- or herself speaking;

3. the hearer imagines hearing the other speaking, i.e., by activating an acoustic impression of the other’s voice in ‘inner’ dialogue;

4. the speaker imagines hearing him- or herself speaking, i.e., the speaker activates an acoustic impression of his or her own voice, as in ‘inner’ dialogue or monologue;

II. Oral Articulation (Encoding):

5. the speaker actually implements the articulatory routine to produce the sound for the hearer;

6. the speaker actually implements the articulatory routine to produce sound for self (as in talking to oneself;

7. the speaker imagines implementing the sound for the other, i.e., silently talking to another in one’s ‘thought’;

8. the speaker imagines implementing the sound for self, i.e., silently talking to one’s self in one’s thought.

Saussure’s understanding of the abstract, categorial basis of phonological form draws attention to the way in which the individual is connected to the ecosocial environment on the basis of schematic sound categories which are independent of any specific expression-substance. These categories do not reproduce or represent an already given acoustic domain in the physical sense. Instead, they are adaptive. They function selectively to categorize aspects of the ‘inner’ and ‘outer’ worlds of the individual in relation to the flow of matter, energy, and information in the ambient flux.

Stimulus Information, Perception, and Value

Saussure's account of the speech circuit does not reduce to one in which the receptor organs of hearing are stimulated by physical sound waves. Such stimuli are inputs to the nerves and are then converted into data which are transmitted to the brain. In reality, this only describes the physiological part of the process. Traditionally, this has formed the basis of most theories of perception. However, and following the principles which J. J. Gibson has established for visual perception, a distinction may be made between receptors and perceptual organs. In the case of hearing, sound waves stimulate the receptors. But, Gibson (1986 [1979]: 57) points out, "an organ, on the other hand, is activated". The ears, like the eyes, are a set of organs which are set on "a head that can turn, and attached to a body that can change location" (Gibson 1986 [1979]: 57). Gibson's point is that the resulting hierarchy of organs constitutes a perceptual system: "Such a system is never fully stimulated but instead can go into activity in the presence of stimulus information. The stimuli which stimulate the organs of hearing contain no such information, nor are inputs to the eardrum sensory impressions on which the brain operates.

Gibson (1986 [1979]: 54) argues that we never see light in the sense of the purely physical energy waves that travel through space:

If light in the exact sense of the term is never seen as such, it follows that seeing the environment cannot be based on seeing light as such. The stimulation of the receptors in the retina cannot be seen, paradoxical as this may sound. The supposed sensations resulting from this stimulation are not the data for perception. Stimulation may be a necessary condition for seeing, but it is not a sufficient. There has to be stimulus information available to the perceptual system, not just stimulation of the receptors. (Gibson 1986 [1979]: 55)

If we do not perceive stimuli, what, then, do we perceive? Gibson responds to this question as follows:

An application of stimulus energy exceeding the threshold can be said to cause a response of the sensory mechanism, and the response is an effect. But the presence of stimulus information cannot be said to cause perception. Perception is not a response to a stimulus but an act of information pick-up. Perception may or may not occur in the presence of information. Perceptual awareness, unlike sensory awareness, does not have any discernible stimulus threshold. It depends on the age of the perceiver, how well he has learned to perceive, and how strongly he is motivated to perceive. If perceptions are based on sensations and sensations have thresholds, then perceptions should have thresholds. But they do not, and the reason for this, I believe, is that perceptions are not based on sensations. There are magnitudes for applied stimuli above which sensations occur and below which they do not. But there is no magnitude of information above which perceiving occurs and below which it does not.

When stimulus energy is transformed into nervous impulses, they are said to be transmitted to the brain. But stimulus information is not anything that could possibly be sent up a nerve bundle and delivered to the brain, inasmuch as it has to be isolated and extracted from the ambient energy. Information as here conceived is not transmitted or conveyed, does not consist of signals or messages, and does not entail a sender and a receiver. (Gibson 1986 [1979]: 55)

A stimulus does not contain information, but a flowing stimulus array of ambient energy does.

Now, Saussure does not distinguish between phonetics and phonology in the modern sense. In general, the division of labour which results from the

specialisation of these respective sub-disciplines has split the study of the sounds of language into three components. First, there is the purely physical acoustic level of the sound waves which are propagated by the mechanical (bodily) event of articulation. Secondly, there is the socio-biological level of physiological phonetics or articulatory phonology. Thirdly, there is the socio-cultural level of the "collective appreciation" of the auditory apperceptions of speech sounds on the part of the users of a given language. It is this third level which Hjelmslev considers to be the most semiotically salient (see Hjelmslev 1954: 177-8 for these distinctions).

Importantly, both Saussure and Hjelmslev recognised that phonic substance is semiotically formed (Hjelmslev 1954: 173). This suggests fruitful links with Gibson's notion of a structured array of stimulus information. In the case of speech, the array is structured on account of the saccadic and rhythmic qualities of speech. In traditional phonetics and phonology, the conception of the speaker-listener is founded on Newtonian concepts of space and time. Thus, the speaker transmits sound waves to the listener. In turn, the listener responds to the physical stimuli in the receptors. These stimuli are then concerted into mental acts inside the brain. In this view, the organism is a processor of information from the outside world. Raw physical stimuli arrive at the receptor organs from external sources and these data are then elaborated as information by the internal cognitive processes of the individual.

Now, I have suggested, following Gibson, that the observer (e.g., the listener) does not respond to physical stimuli as such, but to **stimulus information.** The acoustic array affords information to those social beings who are equipped, trained, skilled, and motivated to pick it up. In my view, the notion of the stimulus array is a useful way of re-thinking and extending Saussure's notion of the speech circuit. Language users are equipped with both a perceptual system as well as a range of meaning-making resources,

including language. In both Saussure and Hjelmslev, the system of pure forms is a resource whereby language users can construe meaning in the information in the stimulus array. The relationship among the three components referred to above has a number of important consequences for the task of re-thinking and re-conceptualising the traditional distinction between phonetics and phonology. First, it cuts across this distinction. Secondly, it subordinates the stimulus of the receptor organs to the notion of an active and embodied perceptual system. Thirdly, it locates the processes of meaning-making in an ecosocial space-time rather than an abstract physical and mathematical one. Fourthly, the language system provides the basis for the twofold de-centring that I referred to in Section 1.

A number of consequences follow from this re-conceptualisation. I shall now discuss these. First, there is a physical-material disturbance in the world of substances, media, and surfaces which are the material basis of the environment in which we live. Such a disturbance is a mechanical event which is physically caused by an embodied social being. This has two most basic forms: (1) the articulatory movements — the vocal tract activity — of the speaker produce compression waves in the medium of the air. The compression waves so produced constitute a trace of the speaker's vocal tract activity in the sense that they "contain" information about that activity; (2) in the case of writing, the movements produced by hand-arm-joint-eye kinaesthesia produce a trace on some surface, thereby constituting a visual record of the hand's act of tracing (Gibson 1986 [1979]: 275). Thus, we see that these two forms of articulatory movement constitute the mechanical events whereby an embodied social agent physically causes speaking and writing to occur.

Vocal tract activity and the movements produced by hand-arm-joint-eye kinaesthesia in writing are forms of self-engendered bodily movement. There is increasing evidence that movement itself is a perceptual system

(Berthoz 1997) and that movement plans a critical role in the formation and development of perception and cognition (Edelman 1989) as well as in meaning-making (Thibault 1997a). The speaker's perception of the movement of the organs of articulation is correlated in time with the production of audible speech sounds just as these are in turn correlated with other external events in the purview of speaker and hearer. This would suggest that all semiotic modalities are somehow associated with patterns of bodily movement, whether language is in the visual or the auditory sensori-motor modality. This would also appear to be the case from the point of view of reception. As Gibson points out, the agent samples and picks up stimulus information through active exploration of the environment rather than being passively stimulated by sensations. Movement is crucial in this regard. In the case of writing and other visual semiotic modalities, movement of the eyes, the head, etc. is critical for the active exploration of and orientation to the stimulus information which has been traced onto a treated surface. Likewise, Saussure's account of the Ear as an active explorer of the auditory array draws attention to the way in which the Ear is a perceptual organ in and entire perceptual system in which head and body may be moved and turned in order to obtain a better take on the stimulus information — the spoken chain — which is heard.

Secondly, to these two types of physical-material disturbance in the world there correspond disturbances in the acoustic and optical arrays, respectively. The former is structured and textured as the saccadic and rhythmic flows of acoustic information discussed above. The second is a visual trace on a surface. Both specify information about the mechanical events which physically caused them. Thus, the acoustic array is a progressive temporal trace of the speaker's vocal tract movements in the act of articulation. The optical array is a progressive record of the physical movements that made the trace on the given surface (paper, blackboard,

etc.). Both types of information can be sourced at an embodied social being. The physical labour is located at a particular person-place.

Thirdly, the stimulus array is an event in an ecosocial environment inhabited by speakers and listeners. Acoustic and optical information are ambient in such an environment. An ecosocial event has the potential to afford meaning to those social beings who are equipped to construe the array in socially meaningful ways. This is where notion of a higher-order linguistic or other semiotic system comes in. Meaning does not inhere in the information that is specified in the array. Such information is only potentially semiotically salient. We make meaning out of such an event by construing meaningful relationships between it and its contexts. In other words, we contextualize it and we do so by selectively drawing on and using the meaning-making resources which language and other semiotic resources afford us.

These processes of contextualisation give rise to the ontological stratification of the array discussed in Section 10. Each stratum so construed is a layer of potential meaning whose meaning may be activated by placing it in some still larger context, social activity, and so on. Meaning is neither in the stimulus array nor is it in the linguistic system. It is in the relations we selectively construe between these in the making of some larger contextual whole. That is why the stimulus array and the value-producing distinctions internal to a given language system are not the same.

Fourthly, the information that is specified by the array is not simply “transmitted” from a speaker to a listener. Both ambient light and ambient sound surround potential points of observation and action in some ecosocial environment. We are constantly surrounded by ambient sound and light and a world which is totally deprived of one or the other is not part

of our normal experience. Ambient sound does not travel in a straight line from A to B. Instead, sound waves are propagated from a source is spherical wave fronts. However, whenever someone speaks, listeners do not detect these wave fronts as compressions waves which, after travelling through the air, stimulate the receptor organs of the listener. Rather, listeners actively orient themselves to a mechanical event which is caused by another embodied subjectivity. That is, we listen to a disturbance of structure in the stimulus array to which there corresponds a physical-material disturbance in the environment. The linguistic system provides the values which we deploy so as to organize a semiotic response to the information in the array. These values are further socio-cultural elaborations and extensions of the in-built biases that Edelman has proposed as the factors which selectively motivate the organism to act in and orient to the world in some (preferred) ways rather than others in order to enhance its survival. These include all of the basic survival functions such that the new-born is motivated by inherent biological factors to seek food, affection, protection, gratification, and so on. They are the motivational factors which kick start the organism's active engagement with its environment and, hence, the self-organisational processes whereby meaning is, in time, built up.

Semiotic values selectively orient participants to some aspects of the world rather than others. They neither pre-specify the world nor do they determine the individual's behaviour in it. Rather, the individual's access to a socially shared system of semiotic values creates the conditions for jointly made and emergent acts of meaning-making or context-building. By selectively attending to the information in the stimulus array, individual's link the perceived sound sequence with some other happening or event, perhaps in some other perceptual modality, e.g., some perceived phenomenon which is seen or touched, etc. at the same time that the sound is heard. In this way, they learn to associate selected patterns of

sound with specific classes of events — real or imagined – in other modalities. Thus, the original value of dialogically orienting to the speech sounds, say, of the other leads to an ongoing engagement with the world. In this way, the association of a given sound sequence with a particular class of phenomenon leads to the organization of neural activity whereby conceptual categories are created in and through the individual's interactive engagement with the world. Thus, the correlated features of a given class of speech sounds with a given class of phenomenon in the real-time of the speech circuit leads to the possibility of time-dependent re-entrant mappings of neural groups. It is in this way that conceptual categories are built up according to Edelman's (1989) theory of re-entry. This is compatible with Saussure's account of the psychic process of association of acoustic image and concept in the brain of the individual. In Edelman's terms, the neural networks which process the given sequence of speech sounds and those that process the perceived phenomenon in some other sensori-motor modality operate disjunctively to generate the neural activity which leads to higher-order conceptual categorization. The neural networks concerned with speech sounds and those with the perceived phenomenon are functionally distinct neural maps which are, however, connected by re-entry. However, the coupling relations between them mean that these can be reinforced and built up by further neural activity. Thus, the correlation over time of a given class of speech sound with a given class of perceptual phenomenon leads to the formation of a meta-map, viz. the development of a higher-order conceptual category.

My proposal is that Saussure's account of the association of acoustic image and concept in the individual's brain is compatible with Edelman's biological account of neural group selection. This does not mean that social-semiological relations reduce to lower-level biological ones. Saussure's account of the speech circuit does not correspond to contemporary models of mind as a processor of information. Instead, his

psychic theory of association is compatible with recent developments in the neurosciences. Moreover, Saussure's semiological theory of **value** enhances Edelman's biological account. The system of values which constitute a given language system goes hand-in-hand with the psychic basis of the individual's relation to the speech circuit. Saussure's term "psychic" implies that the individual's signifying activity is intentionally directed. The system of semiological values in langue means that specific values are placed on the ways in which the individuals in the speech circuit orient to each other and to the circuit as a whole. The system of semiological values means that some ways of psychically orienting to the circuit and, hence, to the phenomena of the world through jointly made signifying activity are preferred, salient, and so on, whereas others are not. Signifying activity cannot take place in a value-free vacuum. There has to be a system of values which motivates and directs the psychic process of making signs in some ways rather than others. In other words, the individual's psychic activity in the speech circuit is mediated and oriented by a system of semiological values. This means that perceiving, acting, and thinking in its higher forms are themselves mediated and oriented by systems of social-semiological values, both linguistic and non-linguistic. Such a system of values thus constitutes a further elaboration and development of the in-built biological values discussed by Edelman. In introducing specific preferences and orientations into the system as to what is possible, good, interesting, salient, relevant, and so on from the outset, the individual is provided with a system of criteria for selectively acting in the world in some ways rather than others. For example, the initial tendency of infants to orient to the voice, the face, etc. of the mother and other caretakers from the very earliest stages probably constitutes one in-built biological value. This preference leads to dialogic interaction with others from the earliest stages. That is, the infant is nudged in the direction of an epigenetic developmental cascade which leads to language itself. Here, there is no opposition or dichotomy between the biological and the

social. Instead, both dimensions are simply parameters in a single ecosocial system which is the real ground of all human signifying activity. Saussure's account of the speech circuit may thus be seen as a precursor of these more recent developments.

Fifthly, the overall system of ecosocial relations cuts across the psychophysical dualism of physical stimuli and mental acts. It also cuts across the dualism of the biological and the social, as I argued above. In this way, we can dispense with the notion of an act of stimulus perception followed by meaning construal. The two are not so separate to start with. In the alternative account, these dualisms are replaced by the notion of an embodied and self-organizing agent which is constituted out of a complex chain of interrelated processes which link, for example, ear-body-brain-vocal tract-environment-linguistic system in one continuous and circular chain of interdependencies. The langue which is deposited in the brain of each individual is the means whereby individuals are connected to a higher-order system of shared meanings. Such an agent both occupies points of action and observation in this overall system of relations and is active and mobile in it:

Ecological optics distinguishes between an unoccupied point of observation in the medium and an occupied point […]. The former is a position where an observer might be situated and the latter is a position where an observer is situated. The ambient optic array is then altered, for it includes a solid angle filled by the observer, having a boundary that is unique to the observer's particular anatomy. It is called the blind region in physiological optics. But it is blind only for exteroception, not for proprioception. It looks like oneself. Its shape depends on the shape of one's nose, the shape of one's head, and the shape of one's limbs. It is altered when a person puts on eyeglasses or when a horse puts on blinders. Thus, whenever a point of

occupation is occupied, the occupier is uniquely specified, whether adult or child, monkey or dog. (Gibson 1986 [1979]: 207-8)

Proprioception, Exteroception and The Ontological Stratification of the Sign

Now, the distinction between signifier and signified is not in my view explained by psychophysical dualism. Instead, it is explained by the distinction between proprioception and exteroception:

The optical information to specify the self, including the head, body, arms and hands [proprioception, PJT], accompanies the optical information to specify the environment [exteroception, PJT]. The two sources of information coexist. The one could not exist without the other. When a man sees the world, he sees his nose at the same time; or rather, the world and his nose are both specified and his awareness can shift. Which of the two he notices depends on his attitude; what needs emphasis now is that information is available for both. (Gibson 1986 [1979]: 116)

The inseparability of these two forms of information is a consequence of the ontological stratification of the sign as signifier and signified (Thibault 1997b: 158-60). Thus, the stratum of the signified is oriented to the environment — the non-self — which surrounds a point of action and observation. Its function is to construe semiotically selected features of that environment as conceptual substance though the lexicogrammatical and semantic categories of a given language system. In so doing, it orients the observer in semiotically salient ways to the environment. The stratum of the signifier serves not only to construe speech sounds perceived by the listener as instances of the phonological categories and structures of a given language system, viz. as phonic substance. It is also the means

whereby the speaker projects internally elaborated signifying acts back into the environment as meaningful activity. In this way, the signifier provides information about the speaker's own embodied activities. This is so in two ways. First, the speaker's vocal tract activity propagates into the environment stimulus information which provides the listener with information about the embodied source of this ecosocial event. Secondly, speakers also hear their own voices in the act of speaking at the same time that they feel the muscular movements of the associated vocal tract activity that they produce.

The distinction between signifier and signified thus ties in with that between proprioception and exteroception. The two sets of distinctions intersect in the embodied agency of the speaker-listener who occupies some point of observation and action in the speech circuit. The ontological stratification of the sign means that signs are psychically oriented towards the construal of information along the two dimensions of self and non-self that are entailed by the distinction between proprioception and exteroception, respectively. The sign thus faces two ways in the process of interfacing the two domains of thought-substance and phonic-substance. Self and non-self are, in this way, connected as one continuous and interdependent flow of matter, energy, and information. The two domains are complimentary and inseparable the one from the other. In this way, the stimulus array looks two ways — to the body of the speaker-listener and to the environment. In recognising both the material basis of speech sounds and the systemic basis of langue, Saussure has provided us with two important components in the construction of an alternative ecosocial account. The speaker-listener is both supported by surfaces and moves through a medium (air) which interfaces with the outer surface of the body. It both occupies a space in the medium and receives information from other sources through the medium.

As I said above, proprioception and exteroception are not separate or dichotomised. Rather, they are two poles of awareness and attention in a single system of relations. Proprioception and exteroception may be related to a further distinction I shall make between semiotic performance and semiotic construal. The first perspective is concerned with the embodying of a semiotic value. In interfacing and motivating vocal tract activity though the categories of a given phonological system, the speaker embodies through sensori-motor activity a semiotic value which he or she projects into the environment. The second perspective — exteroception — has to do with the assigning of a value to that which is embodied in a given performance. In this way, neural activity ("thought") is interfaced with the semiotic categories which are used to interpret and classify our experience of the world. As Rick Iedema suggests, semiotic encoding entails finding an appropriate embodiment for a semiotic value whereas decoding entails finding a value for what is embodied in a given semiotic performance (Iedema 1997: 165-6). The assigning of semiotic values to embodied performances means that these have acquired some degree of discursive determinacy. In other words, the performance has acquired some redundancy and has the possibility of acquiring even more as it undergoes further self-organization. These possibilities are presented in Table 1.

Table 1: Assigning values to vocal tract activity.

The two dimensions of encoding and decoding connect in the speech circuit. This may be seen in the way that a given phonic substance both instantiates a given phonological form at the same time that the phonological form shapes and motivates phonic substance. This can only happen because the speech circuit as a whole functions as a top-down constraint on the functioning of its various components. The individual participants in the circuit and the various levels of their internal organization

described by Saussure — viz. the physical, the physiological, and the psychic — are lower scalar levels whose behaviour is organized by the boundary conditions established by the circuit as a whole along with the higher-order system of langue which mediates the relations between the individual participants. I should point out here that Saussure's conception thus provides an important early recognition of the role of higher scalar levels in the organization of lower scalar ones such as individual physiological and neural activity. Saussure understands the importance of relating the global structure of the circuit as a whole to structures and processes at the lower levels. Seen in this light, it is clear that individual physiological and neural activities are entrained by more global or higher scalar social-semiological ones. As Saussure points out, the psychic process of associating concept with acoustic image in the individual's brain depends on a higher order language system, or langue (CLG: 29-31).

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